

HEAD INJURY BIOMARKER EXPRESSION AND USE OF A SENSOR FISH DEVICE TO CHARACTERIZE PASSAGE CONDITIONS FOR JUVENILE CHINOOK SALMON PASSING THROUGH THE REMOVABLE SPILLWAY WEIR AT LOWER MONUMENTAL DAM, 2008

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ABSTRACT

Fish passage conditions through the newly installed removable spillway weir (RSW) in Spillbay 8 at Lower Monumental Dam were characterized and evaluated by Battelle–Pacific Northwest Division (Battelle) for the U.S. Army Corps of Engineers (USACE) Walla Walla District using Sensor Fish and molecular biomarker assays. The study was performed during March 24–31, 2008, concurrently with HI-Z balloon-tag studies by Normandeau Associates, Inc. Objectives of the Battelle study were to evaluate passage conditions for two injection elevations and the effects of passage on juvenile Chinook salmon wellbeing.

The head injury biomarker assay was used to compare spillway configuration alternatives for passage of migrating juvenile Chinook salmon (*Oncorhynchus tshawytscha*). The expression of α II-spectrin breakdown protein fragments, a diagnostic biomarker used to assess severity of human traumatic brain injury, correlated with observational mortality/malady metrics. Correlation between routinely used fish passage assessment metrics and biomarker assay metrics provided a clear demonstration of the utility of biomarker assays to quantitatively express the difference in safety between fish passage alternatives. Roughly equivalent ability to detect differences between passage route safety for juvenile Chinook required approximately 30 bioassays versus 150 assessments of fish physical injury and mortality.

Sensor Fish that were injected into spill flow at an elevation of 526.5 ft msl (deep-released) were found to have a higher probability of exposure to injurious events (58.7%) than those injected at elevation 531.5 ft msl (mid-released) (42.9%), as well as higher exposure event severity. The most severe events observed using Sensor Fish were collisions on the concrete chute and at the deflector, with deep-released Sensor Fish experiencing the greatest percentage and highest magnitude values for all events. Shear events were only observed at the deflector and in the wake of the deflector for both release elevations, with shear events observed during deep releases having the highest magnitudes. Collisions were most common on the spillway chute, the spillway chute-to-deflector transition, and less frequently on the deflector. Quality of flow was estimated to be better for mid-release than deep release passage routes.